

These are NOT the adopted CDE revised standards, but are a draft version of the revised CO Standards showing how the AASL and ISTE benchmarks could be adapted and embedded in the standards. The additions are shown in **RED**

Life Science

Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.

Prepared Graduate Competencies

The Prepared Graduate Competencies are the Preschool through Grade 12 concepts and skills that all students leaving the Colorado education system must have to ensure success in a postsecondary and workforce setting.

Prepared Graduate Competencies in the Life Science standard:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels
- Explain and demonstrate how living systems interact with the biotic and abiotic environment
- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment
- Explain how biological evolution accounts for the unity and diversity of living organisms

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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain and demonstrate how living systems interact with the biotic and abiotic environment

High School Expectation

Concepts and skills students know include:

1. Matter is cycled and energy is transformed while moving through ecosystems

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ul style="list-style-type: none"> a. Analyze how energy flows through trophic levels and evaluate the potential ecological impacts of a plant-based or meat-based diet b. Analyze and interpret data from experiments on ecosystems where matter has been infused or withdrawn (e.g. drought, fertilizers) c. Develop, communicate, and justify an evidence-based scientific explanation showing how ecosystems follow the laws of conservation of matter and energy d. Define and distinguish between matter and energy, and how they are cycled or lost through life processes e. Demonstrate how Carbon, Nitrogen, phosphorus, and water cycles work 	<p>Inquiry:</p> <ul style="list-style-type: none"> • How does a change in abiotic factors influence the stability or progression of an ecosystem? • What happens when the cycling of matter in ecosystems is disrupted? • What energy transformations occur in ecosystems? Is energy ever transferred without being transformed? • How does the process of burning carbon-rich fossil fuels compare to the oxidation of carbon biomolecules in cells? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Analyze how energy flows through trophic levels, and evaluate the potential ecological impact of plant-based versus meat-based human diets on land use, eutrophication of waters, and global climate change • Compare and contrast how matter and energy are cycled in natural systems versus human managed systems • Use multiple technology tools and resources tools (e.g., digital cameras, graphing calculators, probes, handheld devices, and other emerging technologies) to measure and analyze data from experiments on ecosystems • Use advanced features and utilities of spreadsheet software, (e.g. formulas, graphs and charts), to perform calculations and to organize, analyze and report data. • Use technology tools to find or create computer simulations to analyze how energy flows through trophic levels

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	Nature of Science: <ul style="list-style-type: none">• Address differences between experiments where variables can be controlled, versus those where extensive observations on a highly variable natural system are necessary (eg dead zones in Gulf of Mexico), to determine what is happening• Share experimental data and respectfully discuss conflicting results, describing their work as emulating the practice of scientists• Design ecological experiments in a closed system
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain and demonstrate how living systems interact with the biotic and abiotic environment

High School Expectation

Concepts and skills students know include:

2. Populations interact with each other, as well as abiotic factors in an ecosystem, establishing a state of dynamic equilibrium

Evidence Outcomes

Students can:

- a. Analyze and interpret data about the impact of removing keystone species from an ecosystem, or introducing non-native species into an ecosystem
- b. Analyze and interpret data about the ecological consequences of humans transferring natural resources from their origin to their disposal (e.g., from one reservoir to another) that support claims that the practice is beneficial or risky
- c. Analyze communities in terms of primary and secondary succession as they progress over time
- d. Evaluate data and assumptions regarding different scenarios for future human population growth and their projected consequences

21st Century Skills and Readiness Competencies

Inquiry:

- How do keystone species maintain balance in ecosystems?
- How does the introduction of a non-native species influence the balance of an ecosystem?
- How is the succession of local organisms altered in an area that is disturbed or destroyed?

Applying Science in Society and Using Technology:

- Trace the flow of an abiotic factor from a natural reservoir, to human-manufactured good, to disposal (i.e., from source to sink), and describe the resulting influence on ecosystems (e.g., petroleum, to plastic, to landfill)
- Apply the concept of carrying capacity to humans on Earth, while brainstorming ideas that could expand the present carrying capacity
- Use online environments or other collaborative tools to facilitate the design and development of materials, models, publications, and presentations used to share the results of ecological research
- Create or find computer simulations to model different scenarios for future human population growth and their projected consequences

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	<p>Nature of Science:</p> <ul style="list-style-type: none">• Use models and field data to analyze dynamic equilibrium in ecosystems and compare these with the work of other ecologists• Examine various designs of ecological research with emphasis on the many different ways variables can be tested and the difficulties of isolating variables when studying natural systems• Evaluate how societal norms and/or scientific information are used to form personal opinions on issues like human population growth
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Content Area: Science
Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

High School Expectation

Concepts and skills students know include:

3. Chemical reactions render a cell alive, and are carried out by biomolecules that are produced by living organisms

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ol style="list-style-type: none"> a. Identify biomolecules and their precursors/building blocks b. Develop, communicate and justify an evidence based explanation that biomolecules follow the same rules of chemistry as any other molecule c. Develop, communicate and justify an evidence based explanation regarding the optimal conditions required for enzyme activity d. Infer the consequences to organisms of suboptimal enzyme function (e.g. altered blood pH, high fever), using direct and indirect evidence e. Analyze and interpret data on the body's utilization of carbohydrates, lipids and proteins, in order to support claims that they are used differently in the body 	<p>Inquiry:</p> <ul style="list-style-type: none"> • How are rates of enzyme activity in cells affected by various factors (eg, pH, temp)? • How does one know that enzymes speed up chemical reactions? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Apply knowledge of biomolecular structure and activity to make consumer decisions, especially about diet (i.e. saturated/unsaturated fatty acids, essential/nonessential amino acids, simple/complex carbohydrates) • Explain how high temperatures (fever) may alter cellular enzyme activity • Recognize that many biomolecules can be made in the lab and have the exact same structure and function as ones made by living organisms • Employ data-collection technology and digital measuring devices to gather, view, analyze, and report results for biochemical experiments and investigations. • Select and use technology tools (e.g. spreadsheet software, graphing calculator, handheld devices) to analyze, process and display data

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	Nature of Science: <ul style="list-style-type: none">Critically evaluate scientific explanations in popular media to determine if the research methodology and the evidence presented are appropriate and sufficient to support the claims
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

High School Expectation

Concepts and skills students know include:

4. Cells carry out the interrelated processes of photosynthesis and respiration in order to incorporate the energy from sunlight into energy-rich molecules that are subsequently utilized by all cells

Evidence Outcomes

Students can:

- a. Develop, communicate, and justify an evidence-based scientific explanation about the optimal environment for photosynthetic activity
- b. Discuss the interdependence of autotrophic and heterotrophic life forms (e.g. label a diagram depicting the flow of a carbon atom from the atmosphere, to a leaf, through the food chain, and back to the atmosphere)
- c. Explain how carbon compounds are gradually oxidized to provide energy in the form of ATP, which drives many chemical reactions in the cell

21st Century Skills and Readiness Competencies

Inquiry:

- What variables can be manipulated to change the rate of photosynthesis?
- What variables affect the rate of cell respiration?
- How does body heat (temperature) relate to cellular respiration?

Applying Science in Society and Using Technology:

- Investigate the importance of agriculture to humans
- Explain how various foods (cheeses, yogurts, alcohol and breads) are produced by fermentation (anaerobic respiration) carried out by various organisms
- Connect the experience of muscles cramping after intense exercise to anaerobic respiration in muscle cells
- Assess the integral role of primary producers (marine phytoplankton, rainforest flora) in sustaining all life on Earth
- **Identify and apply common utilities (e.g. pictures, movies, sound and charts in presentation tools) to demonstrate understanding of the interrelated processes of photosynthesis and respiration**

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	<p>Nature of Science:</p> <ul style="list-style-type: none">• Recognize the current understandings of photosynthesis and cellular respiration has developed over time and has become more sophisticated as new technologies have lead to new evidence• Critically evaluate models for photosynthesis and cellular respiration and identify strengths and weaknesses of each
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

High School Expectation

Concepts and skills students know include:

5. Passive and active transport of substances across membranes are used by cells to maintain stable intracellular environments

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ol style="list-style-type: none"> a. Analyze and interpret data to determine the energy requirements and/or rates of substance transport across cell membranes b. Compare organisms that live in freshwater and marine environments, identifying the challenges of osmotic regulation for these organisms c. Diagram the cell membrane schematically, highlighting receptor proteins (as targets of hormones, neurotransmitters, drugs) serving as active links between intra and extracellular environments 	<p>Inquiry:</p> <ul style="list-style-type: none"> • What variables affect the rate of transport across a membrane? • Why is it important that cell membranes are selectively permeable? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Assess the importance of osmotically balanced solutions used in medical settings (e.g., intravenous and ophthalmic solutions) • Research and demonstrate how drugs target receptor proteins in membranes and mimic the action of natural signals there (e.g. hormones, neurotransmitters) • Understand the technology used to support humans on dialysis • Employ data-collection technology such as probes, microscopes, handheld devices, and sensors to gather, view, analyze, and interpret data produced during scientific investigations involving passive and active transport • Select and use technology tools (e.g. spreadsheet software, graphing calculator, handheld devices) to analyze, process and display data • Use technology tools to find or create computer simulations and models of cell transport mechanisms

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	<p>Nature of Science:</p> <ul style="list-style-type: none">• Share experimental data and respectfully discuss conflicting results, describing their work as emulating the practice of scientists• Recognize and describe the ethical traditions of science: value peer review, truthful reporting of methods and outcomes, making work public, and sharing a lens of professional skepticism when reviewing others work• Model social skills and character traits that advance a team’s ability to identify issues and problems and work together on solutions and products.
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Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

High School Expectation

Concepts and skills students know include:

6. Organ systems maintain stable internal environments in response to changing external stimuli

Evidence Outcomes

Students can:

- Discuss how two or more body systems interact to promote health for the whole organism
- Analyze and interpret data on homeostatic mechanisms using direct and indirect evidence in developing and supporting claims about the effectiveness of feedback loops to maintain homeostasis
- Clearly identify assumptions behind conclusions drawn about how disrupted homeostasis leads to a particular disease, in order to provide feedback on the validity of alternative explanations (i.e., distinguish between causation and correlation in analyzing epidemiological data)

21st Century Skills and Readiness Competencies

Inquiry:

- How can an experiment be designed and conducted to test for adaptive homeostasis during exercise and other body activities?
- Where and when are negative versus positive feedback loops more effective in the human body?

Applying Science in Society and Using Technology:

- Identify how the disruption of homeostatic mechanisms may lead to disease, and if severe enough, death
- Compare aspects of a body system in a state of health and disease (e.g. buildup and rupture of atherosclerotic plaque inside a blood vessel to cause a heart attack)
- **Employ data-collection technology such as probes, handheld devices, and sensors to gather, view, analyze, and interpret data produced during scientific investigations involving homeostasis**
- **Use technology tools to find or create computer simulations and models of homeostatic mechanisms**

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	Nature of Science: <ul style="list-style-type: none">• Research and present findings about the results of dietary deficiencies or excesses• Research and present findings about how medical problems that impact life span have changed throughout history due to altered lifestyles and advances in medicine• Differentiate between scientific evidence evaluated by the FDA for drug approval and anecdotal evidence shared among individuals or in magazines/newspapers that a food or supplement is effective for a given problem
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

High School Expectation

Concepts and skills students know include:

7. Many physical and behavioral characteristics of an organism are encoded in heritable genes that serve as blueprints for proteins

Evidence Outcomes

Students can:

- a. Analyze and interpret data that genes are long strands of DNA
- b. Analyze and interpret data on the processes of DNA replication, transcription and translation, and gene regulation and show how these processes are the same in all organisms
- c. Recognize that proteins carry out most cell activities, mediating the effect of genes on physical and behavioral traits in an organism
- d. Analyze and interpret data showing that offspring are not clones of their parents/siblings due to the meiotic processes of independent assortment of chromosomes, crossing over and mutations
- e. Develop, communicate and justify an

21st Century Skills and Readiness Competencies

Inquiry:

- Why is it possible for a cell from one species to express genes from another species as in genetic modification of organisms?
- Why are human offspring not genetic clones of their parents or siblings?
- How is it possible to distinguish learned from instinctual behaviors (eg: imprinting, suckling by mammals)?

Applying Science in Society and Using Technology:

- **Seek and use a variety of specialized resources available from libraries, the Internet, and the community to** investigate how recombinant DNA technology is used in society
- Discern how selective breeding differs from genetic modification, yet shares a common goal
- **Evaluate the benefits and risks of having genetically modified organisms in the food supply by using information and communication technology tools to gather, evaluate, and use information from different sources, then justify a position based on scientific information**
- Discuss the implications of inheriting DNA replication errors

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evidence-based scientific explanation about how genetic mutations can benefit, harm, or have neutral effects on an organism	Nature of Science: <ul style="list-style-type: none">Recognizing that research on GMOs is done in university laboratories as well as by seed companies, discuss the implications of different types of funding and the ethical traditions of science: value peer review, truthful reporting of methods and outcomes, making work public, and sharing a lens of professional skepticism when reviewing others’ workUnderstand that scientists work from the assumption that the universe is a single system in which the basic rules are the same everywhere (e.g., basic principles for genetics apply to all organisms)
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

High School Expectation

Concepts and skills students know include:

8. Cells in multi-cellular organisms differentiate to carry out specialized functions by expressing some of their genes but not others

Evidence Outcomes

Students can:

- a. Develop, communicate, and justify an evidence-based scientific explanation on how cells form specialized tissues, due to the expression of some genes and not others
- b. Analyze and interpret data that shows most eukaryotic DNA does not actively code for proteins within cells
- c. Develop, communicate, and justify an evidence-based scientific explanation of how a whole organism can be cloned from a differentiated (adult) cell
- d. Analyze and interpret data on medical problems using direct and indirect evidence in developing and supporting claims that genetic mutations (and cancer) are brought about by exposure to environmental toxins, radiation, smoking, etc

21st Century Skills and Readiness Competencies

Inquiry:

- Why is it possible to clone a whole organism from an undifferentiated cell?
- Why are stem cells sought by researchers as potential cures to medical problems?

Applying Science in Society and Using Technology:

- Investigate how stem cells may be used to ameliorate medical disorders (e.g. diabetes, Parkinson's, torn cartilage, and damaged hearts). Discuss the ethical and political issues associated with stem cell research, and how these affect research
- Infer how recent research and insights into genomic studies have changed the criminal justice system, impacted the food supply, and broadened medical treatment strategies
- **Participate responsibly and safely in social networks using appropriate tools to collaborate as well as share ideas and knowledge about the ethical and political issues associated with genetic research.**
- **Use technology tools to find or create computer simulations and models of genetic expression in an organism**

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	<p>Nature of Science:</p> <ul style="list-style-type: none">• Debate with peers the advantages and disadvantages of bioengineering (cloning, genetically modifying) organisms in the food supply• Science is influenced by the cultural norms of a society. Discuss the ethical and political issues associated with stem cell research and how these have impacted both the research done and its application
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain how biological evolution accounts for the unity and diversity of living organisms

High School Expectation

Concepts and skills students know include:

9. Evolution occurs as the heritable characteristics of populations change over time

Evidence Outcomes

Students can:

- Develop, communicate, and justify an evidence-based scientific explanation for how Earth's diverse life forms today evolved from common ancestors
- Analyze and interpret multiple lines of evidence supporting the idea that all species are related by common ancestry, such as molecular studies, comparative anatomy, biogeography, the fossil record and embryology
- Analyze and interpret data suggesting that, over geologic time, discrete bursts of rapid genetic change as well as gradual changes have resulted in speciation
- Analyze and interpret data on how evolution can be driven by three key components of natural selection: overproduction of offspring, genetic

21st Century Skills and Readiness Competencies

Inquiry:

- How do subtle differences among closely-related fossil species provide evidence of environmental change and speciation?
- How does studying extinct species contribute to our current understanding of evolution?
- How can patterns of characteristics shared between organisms be used to categorize life's diversity according to relatedness?
- How does modern agriculture affect biodiversity?

Applying Science in Society and Using Technology:

- Evaluate human practices that contribute to antibiotic and pesticide resistance
- Explain how human activities can generate selective pressures on organisms, and what the outcomes of those pressures could be
- **Use information and communication technology tools to gather information from credible sources, analyze findings, and draw conclusions in order to create and justify an evidence-based scientific explanation**
- **Evaluate scientific information for validity of interpretation, accuracy and reliability of data.**

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variation, and differential survival and reproduction	Nature of Science: <ul style="list-style-type: none">• Generate a model showing how a group of organisms is most likely related by common ancestry (an evolutionary tree)• Understand that all scientific knowledge is subject to new findings and that reproducible, corroborated, and converging lines of data yield a scientific theory• Differentiate between the use of the terms "hypothesis", "theory", and "law" as they are defined and used in science compared to the usage of these terms in other disciplines or everyday use
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain and demonstrate how living systems interact with the biotic and abiotic environment

Eighth Grade Expectation

Concepts and skills students know include:

1. Human activities can deliberately or inadvertently, alter the equilibrium in ecosystems

Evidence Outcomes

Students can:

- a. Develop, communicate, and justify an evidence-based scientific example of how humans can alter ecosystems
- b. Analyze and interpret data about human impact on local ecosystems

21st Century Skills and Readiness Competencies

Inquiry:

- Do humans have a unique responsibility to the ecosystems in which they live?
- How can a student be a steward of an ecosystem?

Applying Science in Society and Using Technology:

- Describe how human activities are constantly changing various cycles and habitats in the natural world
- Investigate the laws that preserve and protect wilderness areas, national parks and other natural areas
- Use technology resources such as online encyclopedias, online databases, and credible websites to locate, organize, analyze, evaluate, and synthesize information about human impact on local ecosystems
- Create or find computer simulations to model different scenarios for human impact on local ecosystems
- Recognize bias in print and digital resources while researching an environmental issue

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	Nature of Science: <ul style="list-style-type: none">• Reflect on and describe their work in class as it compares to the practice of professional scientists• Critically evaluate scientific claims in popular media and peer generated explanations regarding interactions in ecosystems and determine if the the evidence presented is appropriate and sufficient to support the claims
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

Eighth Grade Expectation

Concepts and skills students know include:

2. Organisms reproduce and transmit genetic information (genes) which influence traits of individuals in the next generation

Evidence Outcomes

Students can:

- a. Develop, communicate and justify an evidence based scientific explanation regarding how genetic information is passed to the next generation
- b. Use direct and indirect observations, evidence and data to support claims about genetic reproduction and traits of individuals
- c. Gather, analyze and interpret data on transmitting genetic information
- d. Using models and diagrams, predict the phenotype and genotype of offspring based on the genotype of the parents

21st Century Skills and Readiness Competencies

Inquiry:

- How are traits passed from one generation to the next?
- How can patterns in the inheritance of traits be used to predict how frequently they appear in offspring?

Applying Science in Society and Using Technology:

- Evaluate the benefits and risks of genetic engineering (e.g. cloning, genetically modified organisms, gene replacement therapy)
- Understand the application of genome sequencing to the field of medicine
- **Create or find computer simulations to model and predict phenotype and genotype of offspring based on the genotype of the parents**
- **Identify and apply common utilities (e.g. pictures, movies, sound and charts in presentation tools) to demonstrate understanding genetic heritability**

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	<p>Nature of Science:</p> <ul style="list-style-type: none">• Understand the interconnected nature of math and science by utilizing math in the prediction of future generations• Recognize current understandings of genetics has developed over time and has become more sophisticated as new technologies have lead to new evidence• Critically evaluate models used to represent DNA and genes, identifying strengths and weaknesses of these models for representing complex natural phenomena
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain how biological evolution accounts for the unity and diversity of living organisms

Seventh Grade Expectation

Concepts and skills students know include:

1. Individual organisms with certain traits are more likely than other individuals to survive and produce offspring

Evidence Outcomes

Students can:

- a. Develop, communicate and justify an evidence-based explanation as to why a given organism with specific traits will or will not survive and have offspring in a given environment
- b. Analyze and interpret data about specific adaptations to provide evidence and develop claims about differential survival and reproductive success

21st Century Skills and Readiness Competencies

Inquiry:

- What is the relationship between an organism's traits and its potential for survival and reproduction?
- How is the use of the word "adaptation" different in everyday usage than it is in biology?

Applying Science in Society and Using Technology:

- Explore how bacteria have evolved to survive in the presence of the environmental pressure of antibiotics
- Use interactive technology tools to participate as a group in analyzing and organizing information about adaptations and survival
- Use information and communication technology tools to gather information from credible sources, analyze findings, and draw conclusions in order to create and justify an evidence-based scientific explanation
- Create or find computer simulations to model differential survival and reproductive success associated with specific traits in a given environment

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	Nature of Science: <ul style="list-style-type: none">• Follow and describe sound experimental designs to collect data around survival and genetic traits• Describe several ways in which scientists would study genetics and suggest ways that this has contributed to our understandings about survival and populations
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Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

Seventh Grade Expectation

Concepts and skills students know include:

2. Living organisms are composed of atoms, molecules, cells, tissues, organs and organ systems, all of which have specific functions and interactions

Evidence Outcomes

Students can:

- Identify and analyze major organs and organ systems and their functions
- Develop and design a scientific investigation about the human body systems
- Develop, communicate and justify an evidence based scientific explanation regarding the functions and interactions of the human body
- Gather, analyze and interpret data and models on the functions and interactions of the human body

21st Century Skills and Readiness Competencies

Inquiry:

- How does each body system contribute to supporting the life of the organism?
- How do organs and organ systems in the human body interact to perform specific functions?

Applying Science in Society and Using Technology:

- Explore the technologies related to the diagnosis and treatment of diseases of the human body
- Identify and apply common utilities (e.g. pictures, movies, sound and charts in presentation tools) to demonstrate understanding of the functions and interactions of the human body
- Employ data-collection technology such as blood-pressure monitors, stopwatches and other devices to gather, view, analyze, and report results for scientific investigations designed to answer scientific questions about human body systems
- Select and use technology tools (e.g. spreadsheet software, graphing calculator, handheld devices) to analyze, process and display data

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	Nature of Science: <ul style="list-style-type: none">• Critically evaluate models, identifying the strengths and weaknesses of the model in representing our understanding of the human body
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Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

Seventh Grade Expectation

Concepts and skills students know include:

3. Cells are the basic unit of structure and function in living things and have basic structures, and functions

Evidence Outcomes	21 st Century Skills and Readiness Competencies
Students can: <ol style="list-style-type: none"> a. Gather, analyze and interpret data and models on the different types of cells, their structures, components and functions b. Develop, communicate and justify an evidence based scientific explanation regarding cell structures, components and functions c. Compare and contrast the basic structures and functions of plant cells, animal cells and single-celled organisms 	Inquiry: <ul style="list-style-type: none"> • How is the basic structure of a cell related to its function? • How are the components/organelles of a cell related to its function? • How are various cells unique and what do they have in common with other cells? Applying Science in Society and Using Technology: <ul style="list-style-type: none"> • Understand what is meant by a stem cell, and their potential use in medicine • Describe what happens to a cell that causes cancer • Explore how cells can be cultured for the benefit of humanity • Employ technology tools (e.g. microscopes, microscope cameras) to gather, view, analyze, and report results for scientific investigations of cells. • Select and use technology tools (e.g. spreadsheet software, graphing calculator, handheld devices) to analyze, process and display data

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	Nature of Science: <ul style="list-style-type: none">Recognize that our current understandings about cells has developed over centuries of studies by many scientists, and that through continued scientific investigations and advances in data collection we will continue to refine our understandings of cells
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

Seventh Grade Expectation

Concepts and skills students know include:

4. Photosynthesis and cellular respiration are basic processes of life

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ul style="list-style-type: none"> a. Gather, analyze and interpret data regarding the basic functions photosynthesis and cellular respiration b. Use direct and indirect evidence to describe the relationship between photosynthesis and cellular respiration within plants and between plants and animals 	<p>Inquiry:</p> <ul style="list-style-type: none"> • How would you describe the relationship between photosynthesis and cellular respiration? • What energy transformations occur in both the processes of photosynthesis and cellular respiration?
	<p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Explore the significance of plants for human health, as well as the health and survival of Earth's ecosystems • Explain where the energy in food comes from • Describe how fossil fuels are related to photosynthesis • Employ data-collection technology such as probes, sensors, and handheld devices to gather, view, analyze, and report results for scientific investigations regarding the basic functions photosynthesis and cellular respiration • Create or find computer simulations to model the relationship between photosynthesis and cellular respiration within plants and between plants and animals

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	Nature of Science: <ul style="list-style-type: none">• Formulate a testable, falsifiable question about photosynthesis or respiration• Design an experiment to observe photosynthesis or respiration, clearly defining controls and variables• Share experimental data and respectfully discuss discrepant results, describing their work as emulating the practice of scientists
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain how biological evolution accounts for the unity and diversity of living organisms

Seventh Grade Expectation

Concepts and skills students know include:

5. The evolution of organisms over geologic time can be explored through examination of evidence

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ul style="list-style-type: none"> • Interpret and analyze data from the fossil record to support a claim that organisms and environments have evolved over time • Analyze and critique the evidence regarding the causes/effects of a mass extinction event • Analyze and interpret data that shows human evolution 	<p>Inquiry:</p> <ul style="list-style-type: none"> • What do we think life on Earth was like in the distant past and what evidence do we have for this? • Has the frequency of changes in life on Earth always occurred at a constant rate? • How does the evidence of how life has evolved on Earth in the past tell us about Earth today? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Evaluate current concerns over the extinction of organisms around the world, and explore the possible consequences of these extinctions • Cite various scientific arguments regarding the causes/effects of mass extinctions • Use social media (e.g., email, blogs, wikis, discussion groups, etc.) to share research findings about the evidence regarding the causes/effects of a mass extinction event • Use information and communication technology tools to gather information from credible sources, analyze findings, and draw conclusions in order to support a claim that organisms and environments have evolved over time • Evaluate scientific information for validity of interpretation, accuracy and reliability of data.

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	Nature of Science: <ul style="list-style-type: none">• Share data and conclusions, respectfully discussing conflicting interpretations and alternate explanations, describing their work as emulating the practice of scientists• Consider the history of fossil research and the potential implications for what we have learned on current organism studies
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain and demonstrate how living systems interact with the biotic and abiotic environment

Sixth Grade Expectation

Concepts and skills students know include:

1. Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ol style="list-style-type: none"> a. Interpret and analyze data about changes in environmental conditions and populations (e.g., climate change) that support a claim describing why a specific population might be increasing or decreasing b. Develop, communicate and justify an evidence-based explanation about how ecosystems interact with and affect the global environment c. Model equilibrium in an ecosystem, including basic inputs and outputs, to predict how a change to that ecosystem might impact the organisms, populations and species within it (e.g., climate change, 	<p>Inquiry:</p> <ul style="list-style-type: none"> • How ecosystem changes affect biodiversity? • How does biodiversity contributes to ecosystem's equilibrium? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Understand how the creation of green technology helps preserve Earth's biodiversity • Select and use appropriate technologies to gather data, analyze data, and communicate findings • Create or find computer simulations to model equilibrium in an ecosystem • Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.

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removal of a top predator, and introduction of a new species)	Nature of Science: <ul style="list-style-type: none">• Formulate a testable, falsifiable question about how environmental conditions affect organisms, populations, or entire species and design a method to find the answer• Recognize and describe the ethical traditions of science: value peer review, truthful reporting of methods and outcomes, making work public, and sharing a lens of professional skepticism when reviewing others work• Reflect on and describe their work in class as it compares to the practice of professional scientists
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain and demonstrate how living systems interact with the biotic and abiotic environment

Sixth Grade Expectation

Concepts and skills students know include:

2. Organisms interact with one another in various ways providing a flow of energy and matter in an ecosystem

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ol style="list-style-type: none"> a. Develop, communicate and justify an evidence-based explanation about why there are generally more producers than consumers in an ecosystem b. Design a food web diagram to show the flow of energy through an ecosystem c. Compare and contrast the flow of energy with the cycling of matter in ecosystems 	<p>Inquiry:</p> <ul style="list-style-type: none"> • How do different ecosystems cycle matter differently? • What “jobs” do organisms do to facilitate the flow of energy and cycling of matter? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Explore how humans use an understanding of the cycling of matter and energy to help mitigate environmental problems • Identify and apply common utilities (e.g. pictures, movies, sound and charts in presentation tools) to demonstrate understanding of the flow of energy and cycling of matter in ecosystems • Use social media tools to exchange data collected, collaborate to design products or solve problems, and learn scientific concepts by communicating with peers, experts, and other audiences.

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	Nature of Science: <ul style="list-style-type: none">Understand that scientists work from the assumption that the universe is a single system in which the basic rules are the same everywhere, e.g., energy follows the same rules in an ecosystem as it does in physic experiments
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

Fifth Grade Expectation

Concepts and skills students know include:

1. All living things share similar characteristics, but they also have differences that allow us to describe and classify them

Evidence Outcomes

Students can:

- a. Develop, communicate and justify an evidence based scientific explanation of what plants and animals need to survive
- b. Develop, communicate, and justify an evidence based scientific explanation for similarities and/or differences between different organisms (species)
- c. Analyze and interpret data representing variation in a trait
- d. Evaluate and provide feedback on evidence used by others to justify how they classified organisms

21st Century Skills and Readiness Competencies

Inquiry:

- How have classification systems changed over time?
- How are individuals in related species similar and different?

Applying Science in Society and Using Technology:

- Explore how human beings have used technology to be able to live in a variety of climates
- **Select and use grade-level appropriate print and electronic reference materials and teacher-selected Internet sites to answer questions about characteristics of living things**
- **Develop classification systems with peers that can be shared electronically and can challenge other students to answer questions or give opinions adding to the content**

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	Nature of Science: <ul style="list-style-type: none">• Collaborate with peers on similarities and differences of related species• Understand that all scientific knowledge is subject to new findings and that the presence of reproducible results yields a scientific theory
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

Fifth Grade Expectation

Concepts and skills students know include:

2. Human body systems and the body systems of other organisms have basic structures, functions, and needs

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ol style="list-style-type: none"> Develop, communicate and justify an evidence-based scientific explanation regarding how humans address basic survival needs Analyze and interpret data to generate evidence that human systems are interdependent Assess and provide feedback on other scientific explanations regarding how one or more human body systems function to meet basic needs Create and evaluate models of human body systems and organs Compare and Contrast a human system to that of another organism 	<p>Inquiry:</p> <ul style="list-style-type: none"> How are human body systems similar to and different from those found in other organisms? How is the organ impacted when different body systems fail to work correctly? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> Create goals about one's own lifestyle based on an understanding of human body systems Define societal norms/laws intended to protect your health, that are based on scientific evidence Select and use appropriate technologies to gather data, analyze data, and communicate findings Create or find computer simulations to model the functions of human body systems and organs Identify and apply common utilities (e.g. pictures, movies, sound and charts in presentation tools) to demonstrate understanding human body systems

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	Nature of Science: <ul style="list-style-type: none">• Formulate a testable, falsifiable question about how the body functions and design a method to find the answer• Critically evaluate models, identifying the strengths and weaknesses of the model in representing complex natural phenomena
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

Fourth Grade Expectation

Concepts and skills students know include:

1. All organisms have structures and systems with separate functions that help keep them alive

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ol style="list-style-type: none"> a. Develop, communicate and justify an evidence-based scientific explanation of the role of different organs or structures that are important for an organism's survival, in both plants and animals b. Analyze and interpret data to generate evidence that all organisms have structures that are required for survival in both plants and animals c. Assess and provide feedback on other's scientific explanations about the importance of different structures to the organism in both plants and animals d. Create and evaluate models of plant and/or animal systems or parts 	<p>Inquiry:</p> <ul style="list-style-type: none"> • How do plants and animals carry out processes necessary for life? • What different structures to plants and animals use to carry out the same functions? • What adaptations or characteristics help humans survive? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Recognize that different organism structures are adapted to different functions to ensure survival, and humans often manipulate these different structures for our own uses (e.g., building materials, food, and medicines) • Describe how humans have long exploited animals and plants in order to manage them as renewable food resources (e.g., fishing, herding, and agriculture) • Identify tools or materials used by humans that were inspired by animal or plant adaptations • Develop scientific explanations about the importance of different structures in organisms with peers that can be shared electronically or visually and can challenge other students to answer questions or give opinions • Create or find computer simulations to model the functions of plant and/or animal systems or parts

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	Nature of Science: <ul style="list-style-type: none">Assess and provide feedback on other’s scientific explanations about the importance of different structures to the organism in both plants and animals
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain how biological evolution accounts for the unity and diversity of living organisms

Fourth Grade Expectation

Concepts and skills students know include:

2. Fossils can be compared to one another and to living organisms in order to identify similarities and differences and provide evidence about the features of prehistoric environments and give us information about organisms today

Evidence Outcomes

Students can:

- e. Develop, communicate and justify an evidence-based scientific explanation of:
 1. what fossils tell us about a prehistoric environment
 2. what conclusions can be drawn from similarities between fossil evidence and living organisms
- f. Analyze and interpret data to generate evidence about the prehistoric environment
- g. Evaluate whether reasoning and conclusions about given fossils are supported by evidence

21st Century Skills and Readiness Competencies

Inquiry:

- What are some things fossils can't tell us?
- If you wanted something to turn into a fossil, where would you put it to increase its chances of becoming a fossil?

Applying Science in Society and Using Technology:

- Recognize that different interpretations of evidence are possible
- Create or find computer simulations used to model and re-create past environments for study and entertainment
- Use a variety of media and formats to create and edit products that communicate syntheses of information and ideas
- Select and apply digital tools and hand held devices to collect, organize, and analyze data to evaluate theories

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	Nature of Science: <ul style="list-style-type: none">• Formulate a testable prediction about past environments• Make predictions about past environments based on fossil evidence
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain and demonstrate how living systems interact with the biotic and abiotic environment

Fourth Grade Expectation

Concepts and skills students know include:

3. There is interaction and interdependence between and among living and nonliving components of systems

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ol style="list-style-type: none"> a. Describe the components, living and non-living, that compose a habitat b. Model the relationship (food web) between producers and consumers in a specific habitat c. Identify the components that make a habitat type unique. Compare and contrast different habitat types d. Create and evaluate models of the flow of non-living components/resources through an ecosystem 	<p>Inquiry:</p> <ul style="list-style-type: none"> • How are resources shared among organisms in a specific ecosystem/habitat? • How do non-living components of ecosystem influence living components? • What would happen if the Sun's energy no longer made it to Earth? • What would happen if water were removed from an ecosystem? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Describe how humans can have positive impacts on an ecosystem • Recognize that nonliving components which are cycled and recycled through ecosystems need to be protected and conserved • Make a plan to positively impact a local ecosystem • Select and use appropriate technology to gather data, analyze data, and report findings • Use social networking tools to communicate with peers and experts to investigate, create and share information about endangered habitats

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	Nature of Science: <ul style="list-style-type: none">• Critically evaluate models, identifying the strengths and weaknesses of the model in representing complex natural phenomena
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

Third Grade Expectation

Concepts and skills students know include:

1. Life cycles vary from organism to organism

Evidence Outcomes

Students can:

- a. Develop, communicate and justify an evidence-based scientific explanation regarding the stages of how organisms develop and change over time
- b. Analyze and interpret data to generate evidence that different organisms develop differently over time
- c. Share observations, and provide and respond to feedback on other scientific explanations, regarding how organisms develop

21st Century Skills and Readiness Competencies

Inquiry:

- How are life cycles from a variety of organisms similar and different?
- How does an organism change throughout its life cycle?

Applying Science in Society and Using Technology:

- Explore how living things may have different needs at different points in their life cycles
- Identify and apply common utilities (e.g. pictures, movies, sound and charts in presentation tools) to demonstrate understanding of different organism life cycles
- Use a variety of media and formats to create and edit products that communicate syntheses of information and ideas

Nature of Science:

- Compare what is done in class to the work of scientists:
 - Scientists evaluate and use data generated by other scientists to further their own ideas, just like students compare data in class
 - A community of scientists weaves together different evidence and ideas to deepen understanding, similar to how students do investigations and read books to deepen understanding about a concept

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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Explain and demonstrate how living systems interact with the biotic and abiotic environment

Second Grade Expectation

Concepts and skills students know include:

1. Organisms interact with each other and with non-living parts of their habitat to meet their basic needs

Evidence Outcomes	21 st Century Skills and Readiness Competencies
<p>Students can:</p> <ul style="list-style-type: none"> • Develop, communicate, and justify an evidence based scientific explanation about the relationship between an organism and its habitat • Analyze and interpret data about non-living components of a habitat • Assess and provide feedback on other scientific explanations regarding why an organism can survive in its habitat • Use instruments to help make observations about habitat components. For example, data can be collected from a fish tank to assess the environmental health (dissolved oxygen, pH, Nitrogen content) 	<p>Inquiry:</p> <ul style="list-style-type: none"> • What are the basic needs of plants and animals? • How are the basic needs of all living things similar and different? • How do living things depend on their environment? • How does an organism respond when basic needs are not met? <p>Applying Science in Society and Using Technology:</p> <ul style="list-style-type: none"> • Explain how living things depend on the health of their habitats, which need to be protected • Explore how different organisms have different needs • Use appropriate technology to collect data, analyze data, and communicate findings to peers • Use simulations and graphical organizers to explore and depict the relationship between an organism and its habitat

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	Nature of Science: <ul style="list-style-type: none">Describe different ways that scientists seek to understand about organisms and their interactions with the environment
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

Second Grade Expectation

Concepts and skills students know include:

2. Each plant or animal has different structures or behaviors that serve different functions

Evidence Outcomes

Students can:

- a. Develop, communicate and justify an explanation as to why a habitat is or is not suitable for a specific organism
- b. Analyze and interpret data about structures or behaviors of a population that help that population survive
- c. Share observations, and provide and respond to feedback on ideas about the advantages of specific structures and behaviors

21st Century Skills and Readiness Competencies

Inquiry:

- What different structures do plants and animals have that perform the same functions? For example, what different structure do plants and animals have to acquire water?

Applying Science in Society and Using Technology:

- Explore how a single environment can support a variety of living things that use different kinds/amounts of resources
- With teacher guidance, use technology tools to create and present ideas (e.g. podcasts, simple slide show)

Nature of Science:

- Share reasoning about the advantages of certain structures or behaviors

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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment

First Grade Expectation

Concepts and skills students know include:

1. Offspring have characteristics that are similar to but not exactly like their parents (For both plants and animals)

Evidence Outcomes

Students can:

- a. Develop, communicate and justify evidence-based ideas regarding similarities and differences between parents and offspring
- b. Analyze and interpret data regarding the similarities and differences between offspring and their parents
- c. Question peers about evidence used in developing ideas about similarities and differences between parents and offspring

21st Century Skills and Readiness Competencies

Inquiry:

- How are you like your parents?
- In what ways do offspring resemble their parents?

Applying Science in Society and Using Technology:

- Understand that diversity, or variation exists within populations of living organisms
- **Select and use appropriate sources, including picture dictionaries, beginning encyclopedias, and beginning databases to answer questions**
- **Interpret information represented in pictures, illustrations, and simple charts.**

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	Nature of Science: <ul style="list-style-type: none">• Compare and contrast their data with their peers, recognizing this is a process scientists would do in their work
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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

First Grade Expectation

Concepts and skills students know include:

2. An organism is a living thing that has physical characteristics that help it survive

Evidence Outcomes

Students can:

- Identify organisms and develop, communicate, and justify evidence based scientific explanations for classifying them into groups
- Analyze and interpret data about the needs of plants and animals
- Use direct observations and other evidence to support and respond to feedback about ideas concerning physical characteristics that help plants/animals survive

21st Century Skills and Readiness Competencies

Inquiry:

- How do the needs of plants and animals differ?
- What helps a (specific plant or animal) survive?

Applying Science in Society and Using Technology:

- Identify characteristics of local animals and plants that help them survive in the local environment. For example, identify that the thick fur of animals (raccons, bears, mule deer) helps them survive the cold winters in Colorado
- Recognize that a living thing can be harmed if needed resources are lacking
- **Interpret information represented in pictures, illustrations, and simple charts.**

Nature of Science:

- Ask testable questions about the needs of an organism
- Predict the outcome for an organism if a need is removed

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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels

Kindergarten Expectation

Concepts and skills students know include:

1. Organisms can be sorted by their physical characteristics

Evidence Outcomes

Students can:

- a. Sort a group of items based on observable characteristics
- b. Communicate, and justify an evidence based scientific rationale for sorting organisms into categories

21st Century Skills and Readiness Competencies

Inquiry:

- What do living things have in common?
- What characteristics are useful for sorting and classifying organisms?

Applying Science in Society and Using Technology:

- Develop ideas by observing patterns in the natural world
- Explain that there are many ways of classifying a group of organisms
- Use scientific tools in their investigations and play (i.e., magnifying glasses, sorting blocks, rulers, etc.)

Nature of Science:

- Share scientific ideas verbally in a clear way
- Question peers about reasons for their sort and push for use of evidence to support their ideas

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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels
- Explain and demonstrate how living systems interact with the biotic and abiotic environment

Prekindergarten Expectation

Concepts and skills students know include:

1. Living things have characteristics and basic needs

Evidence Outcomes

Students can:

- a. Use senses to gather information about living things
- b. Observe and explore the natural processes of growing, changing, and adapting to the environment
- c. Ask and pursue their questions through simple investigations and observations of living things
- d. Collect, describe and record information about living things through discussion, drawings and charts

21st Century Skills and Readiness Competencies

Inquiry:

- What do living things need in order to survive?

Applying Science in Society and Using Technology:

- Identify characteristics and needs of various living things within your community
- Use scientific tools in investigations and play (i.e., magnifying glasses, sorting blocks, etc.)

Nature of Science:

- Openness to and curiosity about new tasks and challenges (Predisposition to explore and experiment)

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Content Area: Science

Standard: Life Science

Prepared Graduate Competencies:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels
- Explain and demonstrate how living systems interact with the biotic and abiotic environment

Prekindergarten Expectation

Concepts and skills students know include:

2. Living things develop in predictable patterns

Evidence Outcomes

Students can:

- a. Identify common needs of familiar living things (e.g. food, air, water)
- b. Predict, explain and infer patterns based on observations and representations of living things, their needs and life cycles

21st Century Skills and Readiness Competencies

Inquiry:

- What are some similarities and differences in how living things develop?
- How do the adults of various animals compare to juveniles of that animal?

Applying Science in Society and Using Technology:

- Investigate how living things in your community develop
- **Interpret information represented in pictures, illustrations, and simple charts.**

Nature of Science:

- Show a capacity for invention and imagination when looking for patterns of development

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